# REALIZING A MATHEMATICS EDUCATION FOR NATION-BUILDING IN SOUTHEAST ASIA IN THE NEW MILLENNIUM

**Wee Tiong Seah & Alan J. Bishop**
*Monash University, Australia*

Abstract: Provision of general education, including mathematics education, in Southeast Asia over the last thirty to forty years have been instrumental in creating economic wealth and maintaining socio-politico stability in the region. (The mainly cognitive) developments in mathematics education have opened many windows of knowledge, and equipped many with the latest scientific/technological know-how. The region's entry into the new millennium is, however, one accompanied by tremendous economic, technological and social changes and challenges. Mathematics education's response in the region should then also include the realization of system intentions of balancing cognitive and affective developments. Indonesia's 'Panca Sila', Malaysia's 'Rukunegara' and 'Nilai-Nilai Murni', as well as Singapore's 'Shared Values' and 'Desirable Outcomes of Education' are examples of governmental desires to instill values through school subjects. Specific mathematics curricula also promote values education. But values education in mathematics teaching has always been ongoing. Values in the mathematics classrooms – mathematical, mathematics educational, and general educational – are situated in the contexts of institutional, epistemological and societal values. There are implications for certain Western values in the Asian societies. Thus, the nature and pervasiveness of values transmission need to be investigated and made more explicit. This is crucial for the continual optimization of mathematics teaching/learning, and in contributing towards developing the citizen in a pupil.

## Introduction

Asian schools generally "promote learning and … strengthen public morality and hence social order" (Cummings, 1996). In fact, the formulation and refinement of national education objectives and strategies are often guided by national economic and social policies (see, for examples, Malaysia Ministry of Education, 1993; Singapore Ministry of Education, 1998b; Thailand Ministry of Education, 1997). Provision of general education, including mathematics education, in Southeast Asia over the last thirty to forty years have been instrumental in creating economic wealth and maintaining socio-politico stability in the region.

Together with other school subjects, (the mainly cognitive) developments in mathematics education have opened many more windows of knowledge, and equipped the people of this region with the latest scientific/technological know-how. Lim-Teo (1998) cites the case for Singapore. Also, the school mathematics reforms in Singapore over the last two years – which includes a reduction of curricular content by up to 30% (Singapore Ministry of Education, 1998a) and a well-defined statement for IT-based learning and teaching (Teo, 1997) – reflect the Singapore government's aim to actualize the concept of 'thinking schools, learning nation' in the looming knowledge and information age. Likewise, Malaysia's KBSR primary mathematics curriculum introduced in 1983 includes a new topic, 'commercial practices', which "aims to acquaint pupils with the elements of commercial practices, hence stimulating their interest in business and commerce" (Wong, 1993, p. 97). The timing was appropriate for a country which was moving from an agriculturally-based to an industrial economy.

**Fostering of Asian values in the new millennium**

As Southeast Asia steps over the threshold of the new millennium, she is reminded that the new era will continue to be one of great economic, technological and social changes and challenges. The region is still recovering from an economic recession which had sent shock waves beyond her shores in 1997. With the proliferation of internet and/or satellite dish connections, it is increasingly difficult for governments in the region to censure undesirable foreign influences and values transmitted through these media. Faced with these issues, much responsive attention can be focussed on the cognitive dimension, such as through general education programmes/campaigns, and fostering creativity and problem-solving skills. There is also an affective dimension operating, but often it is not explicitly stressed. Examples of affective measures are the provision of conducive environments to encourage the attainment of creativity and problem-solving skills, and the deterrent effect of tough penalties.

Indonesia's 'Panca Sila', Malaysia's 'Rukunegara' and 'Nilai-Nilai Murni', as well as Singapore's 'Shared Values' and 'Desirable Outcomes of Education' are examples which reflect Southeast Asian governments' efforts to maintain a sense of national identity and social cohesion amidst such challenges. These are also affective in nature. These governmental documents encourage the inculcation of desirable values through school subjects (Malaysia Ministry of Education, 1993; Singapore Government, 1991; Singapore Ministry of Education, 1998b; Swadener & Soedjadi, 1988; Tan, 1997). The objectives statement in Thailand's current education reform is entirely affective in nature (Thailand Ministry of Education, 1999). Swadener and Soedjadi (1998) establish the link among the five fundamental principles of the 'Panca Sila', values in mathematics education, and pupils' affective development. Tan (1997) shows how the sixteen values embodied in Malaysia's 'Nilai-Nilai Murni' may be more explicitly harnessed in the science classroom in the nurturing of the compassionate scientist.

**Values – an affective educational objective**

Afterall, educational objectives can be cognitive or affective in nature. Eight years after the publication of the well-known 'Taxonomy of Educational Objectives' (which deals with cognitive goals), Krathwohl, Bloom and Masia (1964) released another similar taxonomy, corresponding instead to the affective domain. In their view, affective objectives are located along a multidimensional internalisation continuum (Chap. 3), so that the taxonomy actually represents an arbitrary organisation into 'stages'. In order of increasing levels of internalisation, the five broad stages are: receiving (attending), responding, valuing, organisation, and characterisation by a value or value complex.

More recently, Raths, Harmin and Simon (1987) suggest that values derive from value indicators (which include attitudes, beliefs and interest) after going through the valuing process. The satisfaction of all seven criteria must take place in such a valuing process, i.e. choosing freely, choosing from alternatives, choosing after thoughtful consideration of the consequences of each element, prizing/cherishing, affirming to others, acting with the choice, and acting repeatedly in some pattern of life. Clarkson and Bishop (1999) coin an operational definition of a value as a "belief in action" (p. 3).

The many studies on value indicators (such as Ensor, 1998; Forgasz & Leder, 1998; Galbraith & Haines, 1998; Kaleva, 1998; Perry & Howard, 1999; Philippou & Christou, 1998; Ruffell, Mason, & Allen, 1998; Tirta Gondoseputro, 1999; and for a review of earlier works, McLeod, 1992 – all these and more for mathematics education alone!) have been going on for quite some time. Such qualities as attitudes and beliefs towards school mathematics, however, may not be applicable in

nurturing the citizen in pupils. On the other hand, not only are values able to complement cognitive pedagogic strategies to bring about the best academic performance in pupils, they are instrumental in shaping their outlooks and perceptions towards education, and the world at large. Also, there have been documented inconsistencies between attitudes/beliefs and subsequent actions (see, for examples, Lim-Teo, 1998, p. 326; Sosniak, Ethington, & Varelas, 1991; Thompson, 1992; Tirta Gondoseputro, 1999). Lastly, the TIMSS data for Japan and Singapore illustrate a negative correlation between pupil academic performance in mathematics and attitudes/beliefs (Akiyama, Hirano, & Sakai, 1999; Lim-Teo, 1998).

**Mathematics education and values**

As has been for the last few decades, school mathematics education plays a key role in preparing a nation's young to face the numerous economic, technological and social changes and challenges. Singapore's Minister for Education, RAdm (NS) Teo Chee Hean, identifies a strong foundation in mathematics as one of the 'four key ingredients … [which are] decisive in whether an economy can make it to the ranks of a Knowledge Based Economy" (Teo, 1999). At the same time, the role of school mathematics in general education for the 21st century will be the theme of a plenary session in the next International Congress on Mathematics Education.

National mathematics curriculum statements also echo the role of school mathematics in general education. For example, as stated in Singapore's lower secondary mathematics syllabus, "the primary aim of the [Singapore] mathematics curriculum is to enable pupils to develop their ability in mathematical problem-solving" (Singapore Ministry of Education, 1990, p. 3). While this focus on problem-solving deals with the cognitive dimension, it also reflects the activist view (see Dormolen, 1986) of mathematics learning, promoting pupil valuing of intuitive reasoning and discovery learning. On the other hand, deductive reasoning remains a useful skill to prepare pupils for the future; the syllabus encourages the fostering of this skill as one of the thinking and heuristics processes for effective problem-solving. Implied here is the mathematical value of rationalism (see Bishop, 1988). The syllabus also promotes relational understanding (see Skemp, 1979): lower secondary pupils are to be able to "recognize the relationships between topics …. [and to] become aware of the application of mathematics in other subjects" (Singapore Ministry of Education, 1990, p. 5).

Thus, instead of being a value-free and impersonal school subject, mathematics provides teachers with opportunities to inculcate desirable values in their pupils. The current situation, however, is that academic/research attention in affective issues is more often directed at other subjects, such as the languages, literature studies, history, physical education (e.g. Aplin & Saunders, 1996; Lee & Cockman, 1995), and the sciences (e.g. Allchin, 1999; Proctor, 1991; Tan, 1997). This is perhaps because these other subjects deal more directly and explicitly with aspects of life experiences.

So, what are the values one may find in the mathematics classroom? Taking into account the different definitions of the term 'value' by scholars such as Bishop (1996); Fraenkel (1977); Krathwohl, Bloom and Masia (1964); McConatha and Schnell (1995); Nixon (1995); Raths, Harmin and Simon (1987); Swadener and Soedjadi (1988); and Tan (1997), values in mathematics education may be taken to represent one's internalization and 'cognitisation' of affective variables (such as beliefs and attitudes) in the context of the culture of one's community. They are inculcated through the nature of mathematics and through one's experience in the mathematics classroom. These values equip one with a pair of cognitive and affective lenses which shape and modify one's way of perceiving and interpreting the world, and guide one's choice of course of action.

**Categories of values in the mathematics classroom**

Certainly, moral, civic, nationalistic and social values constitute one such category of values in the mathematics classroom. These are the nature of the desirable values of the Malaysian society to be taught by mathematics teachers in the Malaysian KBSM secondary mathematics curriculum (see Wong, 1993). We also often find textbook writers and classroom teachers who deliberately design the 'story' in any selected problem sum so as to promote socially-desired mindset and/or behavior.

The focus of this paper, however, is on the use of mathematics content and pedagogical values in cultivating the citizen in the pupil. In this context, Bishop (1996) categorizes values in the mathematics classroom into general educational, mathematical, and mathematics educational. General educational values would include moral, civic, nationalistic and other values which education in general aims to inculcate in pupils. For schools affiliated to particular religions, these would also include religious values. Mathematical values are associated with the nature of mathematics. Bishop (1998) identifies three complementary pairs of such values, i.e. rationalism and objectism, control and progress, openness and mystery (see Bishop, 1988, for details).

On the other hand, mathematics educational values stem from the norms and practices in the teaching of mathematics in the classroom. One example of mathematics educational values is teacher facilitation of cooperative group learning. Through such peer interactions, pupils develop the affinity for – and confidence in – learning in group settings, an important life-skill in our increasingly connected society.

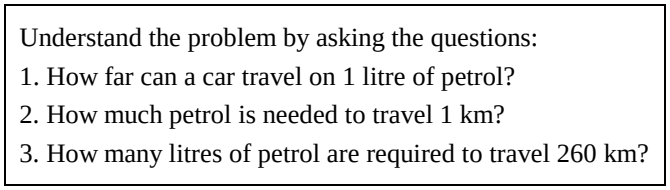
Of course, these three categories of values do not exist mutually exclusive of one another. For example, promoting the sensible and responsible use of technology to support computations is both a mathematics educational and general educational value. One may also argue that creativity embodies all the three categories of values.

Additionally, these values in the mathematics classroom are situated in increasingly larger contexts of institutional, epistemological, and societal values. Each of these influences the form and value of the others. In fact, this perspective reflects Billett's (1998) levels of knowledge genesis. It is worthwhile to highlight that epistemological values are continually being constructed, reviewed and modified by mathematicians and mathematics education researchers. These would be equivalent to what have been referred to in science education as 'epistemological and supporting values' (Tan, 1997) and 'values of science and research ethics' (Allchin, 1999).

**Portrayal of values in mathematics textbooks**

Textbooks, too, represent and transmit mathematical and mathematics educational values in the text (Dowling, 1996; Fauvel, 1991). Consider the example shown in Figure 1, which was taken from a Singapore textbook:

**Figure 1: Transmitting the mathematical value of openness and the mathematics educational value of activist view of knowledge**



By inviting pupil question posing, the text encourages the examination of a problem from different perspectives. At least two values are being promoted (implicitly?) here. Firstly, there is a sense that mathematical knowledge is open and transparent. This democratic perspective is encapsulated in Bishop's (1988) discussion of the mathematical value of openness. Secondly, there is a promotion of a mindset of approaching problems from different directions and angles. There is value in the construction of new insights and knowledge in the course of solving a problem. This activist view of mathematics knowledge (Dormolen, 1986) – a mathematics educational value – can certainly be extrapolated to facilitate our co-existence with others, especially with people from different socio-cultural backgrounds.

**The current situation and possible solutions**

The inculcation of the different categories of values in the mathematics classroom has, of course, been taking place all the time. The academic and practical significance, however, is that it is more often than not an implicit exercise (Bishop, 1991). A danger with this is that without a greater level of teacher awareness of the types of values being represented through textbooks, prepared worksheets and teacher decisions, pupils may be receiving mixed signals from the mathematics class, from the different subject classes, as well as from the school in general. Seah's (1999) analysis of some Singaporean and Australian lower secondary mathematics textbooks, for example, reveals that certain mathematical and mathematics educational values are consistently more emphasized than their corresponding complementary values. The other textbook series and the mathematics teachers in these countries do not necessarily emphasize the same values. A school education which fails to espouse a coherent set of affective expectations is especially harmful to teenage pupils who are already undergoing through a crucial period of self-exploration and personality consolidation themselves.

Another worry is that not all mathematical and mathematics educational values may be appropriate in the context of the (Southeast) Asian culture. Afterall, many mathematics pedagogical strategies have been developed overseas. This extends Clarke's (1999) observation that "one criterion for the effectiveness of adapted non-local activity is its congruence with the existing local culture" (p. 24). Wong (1993) calls for a critical re-evaluation of Western mathematics teaching approaches to assess "their integration with local [i.e. Malaysian] goals (in particular the inculcation of values through mathematics instruction)" (p. 108). The Islamic view of knowledge acquisition encourages pupil attainment of peace of mind and freedom from any distraction of the senses (Moosavi-Movahedi, 1999). Will this lead to a dilemma for a mathematics teacher in an Islamic school when this religious value is weighed against the mathematics educational value transmitted through peer discussions and group investigations? In fact, the Taiwanese research project on values in school mathematics classes expresses a concern for the implicit influences of educational values underpinning foreign ethos in the process of adapting American teaching methods (Chin & Lin, 1999).

Clearly, a first step to take is to raise awareness among our pre- and in-service teachers of mathematics that different categories of values are transmitted through the teaching of mathematics, that they are permanent and influential affective qualities, and that they are not only able to affect the level of pupil performance, but also to help mould the future of each of our nations. A challenge here may be to convince these teachers and teacher trainees of the impact and influence of mathematical and mathematics educational values, 'submerged' as they often are in documents and in pupil/teacher-pupil interactions. Through self-reflections and analyses, teachers and teacher-trainees can remind themselves that their choices of decisions at decision points in class transmit

different values. They can also better understand how competing values interact in the context of personal cultural and social experiences in their own constantly evolving personal value systems.

Regarding a teacher's personal value system, there are instances when it will be in conflict with what the teacher is expected to, and/or intends to, teach. What are the mathematics content and pedagogical values being emphasized by our teachers? How much control does the teacher have over the set of values he/she will be transmitting in the teaching of mathematics? Can competing values be personally moderated? These are significant research questions, and collaborative research projects are currently underway in Australia, Republic of China and Singapore to improve our understanding in this area.

## Conclusion

Standing as we are now at the doorstep of the new millennium, one of the constants in a time of changes, challenges and uncertainties in Southeast Asia is expected to be continual state emphasis on education as a means to achieve greater economic progress and social stability. The affective dimension of mathematics education in general, and the transmission of the internalized values in particular, complements the cognitive dimension to boost pupil understanding and performance in the subject. Equally importantly, a more conscious inculcation of mathematical and mathematics educational values will help to realize a mathematics education system to contribute directly to nation-building among Southeast Asian nations in the years 2000 and beyond.

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